
Appendix B

Quality Assurance Plan: Study of Potential Impacts of Hydraulic Fracturing of Coalbed Methane Wells on Underground Sources of Drinking Water

The U.S. Environmental Protection Agency (EPA), bases environmental protection efforts on the best available scientific information and sound science. The credibility of the resulting policy decision depends, to a large extent, on the strength of the scientific evidence on which it is based. Sound science can be described as organized investigations and observations conducted by qualified personnel using documented methods and leading to verifiable results and conclusions (SETAC, 1999).

This Quality Assurance Plan for data collection describes the procedures to be used for a systematic and well-documented, graded approach to realizing the above-stated goal for the "Study of Potential Impacts of Hydraulic Fracturing of Coalbed Methane Wells on Underground Sources of Drinking Water." This Quality Assurance Plan (developed following the guidelines of EPA publication 240/B-01/003) guides the production of a set of data and scientific findings that are sound, with conclusions supported by the data.

1.0 Project Management

This section of the Quality Assurance Plan addresses the basic area of project management, including the project history and objectives, and roles and responsibilities of the participants.

1.1 Project and Task Organization

Overall project management will be provided by the EPA's Office of Water, Ground Water and Drinking Water (OGWDW), Ground Water Protection Division. Data will be gathered by the EPA OGWDW contractor.

The contractor will compile the gathered data into a draft summary report, review the draft report, and submit the draft report to EPA and other federal agencies for review. Once the contractor has addressed comments from EPA and other federal agencies, EPA will submit the draft report to a Peer Review Panel for their comments. Following receipt of comments from the Peer Review Panel, EPA and its contractors will respond to those comments. This comment and response cycle will occur once more with EPA, prior to production of the final summary report. The final summary report will then be available for stakeholder review and comment. Table B-1 is a list of the members of the Peer Review Panel.

1.2 Problem Definition and Background

Hydraulic fracturing is a half century-old technology used in oil and natural gas production. The technique allows oil or natural gas to move more freely from the rock pores where it is trapped to a producing well that can bring the oil or gas to the surface.

After a well is drilled into a reservoir rock that contains oil, natural gas, and water, every effort is made to maximize the production of oil and gas. One way to improve or maximize the flow of fluids to the well is to connect many pre-existing fractures and flow pathways in the reservoir rock with a larger fracture. This larger, man-made fracture starts at the well and extends out into the reservoir rock for as much as several hundred feet. The man-made or hydraulic fracture is formed when a fluid is pumped down the well at high pressures for short periods of time (hours). The high pressure fluid (usually water with some specialty high viscosity fluid additives) exceeds the rock strength and opens a fracture in the rock. A propping agent, usually sand carried by the high viscosity additives, is pumped into the fractures to keep them from closing when the pumping pressure is released. The high viscosity fluid becomes a lower viscosity fluid after a short period of time. Both the injected water and the now low viscosity fluids travel back through the man-made fracture to the well and up to the surface.

EPA is conducting a study of possible impacts hydraulic fracturing may have on Underground Sources of Drinking Water (USDWs). The study will focus on hydraulic fracturing used specifically for enhancing coalbed methane production. EPA, through its contractors and subcontractors, will gather information on the hydraulic fracturing process and request comment from the public on contamination allegedly due to hydraulic fracturing practices. In this initial effort, EPA will not incorporate new, scientific fact-finding, but will use existing sources of information, and consolidate pertinent data in a summary report to serve as the basis for the study. EPA will decide if additional research is required based on the findings from this effort.

1.3 Project and Task Description

The purpose of this project is to assist EPA in determining if a threat to public health as a result of underground sources of drinking water (USDW) contamination from hydraulic fracturing of coalbed methane (CBM) wells exists, and if so, is high enough to warrant further study. EPA intends to complete this study before making regulatory or policy decisions regarding hydraulic fracturing. The first step in investigating the potential for hydraulic fracturing to threaten public health is to define mechanisms by which contamination could occur. EPA defined two hypothetical mechanisms by which hydraulic fracturing of coalbed methane wells could potentially impact USDWs:

1. The intentional direct injection of fracturing fluids into a USDW; and
2. Creation of a hydraulic communication between the target coalbed formation and adjacent USDWs.

The objective of the project is to consider these two mechanisms, based on existing literature and data, when evaluating whether hydraulic fracturing endangers USDWs. Information will be collected regarding the geology and hydrogeology of the coalbed methane production regions, the processes used to hydraulically fracture coalbed methane production wells, and the fluids used in the fracturing process. EPA will also evaluate water supply incidents possibly related to hydraulic fracturing of coalbed methane production wells. EPA will rely on currently available literature and data as the primary source of information for project efforts.

1.4 Quality Objectives and Criteria

To ensure that findings are sound, the following quality assurance questions will be addressed for all sources of data:

- What was the purpose of the study?
- Whose data are they?
- What is their source?
- Are the data reliable?
- Is the interpretation biased?

This Quality Assurance Plan establishes a set of guidelines and general approaches to assess available data and information in a clear, consistent, and explicit manner. Data collection and review according to this process will make conclusions more transparent, and thus more readily understood and communicable to stakeholders.

The objectives of the systematic expert review of data and information are transparency, avoidance of bias, validity, replicability, and comprehensiveness. Following a data and information review protocol can ensure a common understanding of the task and adherence to a systematic approach. The components of this Quality Assurance Plan are as follows:

- Specification of the hypotheses to be addressed;
- Justification of the expertise represented in the expert investigators team;
- Specification of the methods to be used for identification of relevant studies, assessment of evidence of the individual studies, and interpretation of the entire body of available evidence (WHO, 2000);
- Review process; and
- Communication of findings.

Revisions to the Quality Assurance Plan may be necessary as new aspects of the task emerge during the study development process.

1.5 Special Training and Certification

To provide authoritative assessments of data and information, it is important to rely on expert investigators to evaluate the evidence, draw conclusions on the existence of actual

and/or potential hazard, and estimate the magnitude of the associated risk. The team of expert investigators, which will evaluate the evidence associated with this study, possesses the following qualifications:

- Formal training in basic scientific principles applicable to the project;
- Basic knowledge of the subject or the body of technical information pertaining to it;
- Experience in scientific review of technical data and information;
- Ability to use descriptive and analytical tools appropriately;
- Ability to design studies to test hypotheses;
- Ability to communicate results accurately to decision-makers and stakeholders; and
- Experience coordinating multiple tasks and disciplines to ensure timely and accurate delivery of study components.

The above-listed qualifications ensure that the project team will be able to fulfill the objectives of this project.

1.6 Documents and Records

Documents to be produced for the project and submitted to EPA include the draft and final summary reports (hard copy and digital format). Information and records to be included in the data report package following completion of the project include:

- Maps (hard copies);
- Scientific literature (hard copies);
- Books (hard copies);
- Database search results (hard copies);
- Logbooks (hard copies); and
- Site visit notes and photographs (hard copies).

All the above-listed materials will be maintained by the EPA OGWDW.

2.0 Data Generation and Acquisition

Processes and methods used to collect the data and information must be clear, explicit, and based on valid practice. It is important to adhere to a rigorous and thorough approach to the processes of data collection and data logging.

In this initial effort, EPA will not incorporate new, scientific fact-finding, but instead will use existing sources of information, and consolidate pertinent data in a summary report to serve as the basis for the study. EPA will decide if additional research is required based on the findings from this effort. As such, this Quality Assurance Plan does not cover areas of sampling process design, sampling methods, sample handling and custody, analytical methods, quality control, instrument/equipment testing, inspection, and maintenance, instrument/equipment calibration and frequency, and inspection/acceptance of supplies and consumables.

2.1 Non-direct Measurements

All information summaries and conclusions developed during the course of this project will be based on non-direct measurements. Available literature and data will be used as the primary source of information for the summary report. An extensive literature search will be conducted using the Engineering Index and GeoRef on-line reference databases. Searches will be guided by subject topics and key words within the following areas:

- Hydrogeology of the coalbed methane basins;
- Hydraulic fracturing practices;
- Fracture behavior;
- Hydraulic fracturing fluids and additives; and
- Information regarding water quality incidents.

All search results will be printed, catalogued and surveyed for pertinent journal articles, books and conference proceedings that may contain information meeting the specific data needs of the summary report. All pertinent articles will be acquired from the University of Texas Library in Austin, Texas, as this library's holdings include an extensive collection of oil and gas-related publications. References from the articles will be researched and documents relevant to the study will be acquired. All papers collected for the study will be archived by topic for future reference.

To verify facts extracted from the literature, state regulatory agencies, geological surveys, gas companies, service companies and other relevant organizations will be contacted by telephone. Dated telephone logs will be used to document all communications. Personal conversations with the employees of the various organizations may yield additional information in the form of literature, figures and maps. These will be collected and referenced in conjunction with literature identified in the literature searches.

Internet-based searches will be used to locate additional information. Relevant web sites will be located using various search engines such as GoogleTM, Yahoo®, and Alta Vista®. More specialized search engines, such as those provided on state geological survey web sites, will also be searched. All relevant web sites will be logged and referenced appropriately. Efforts will be made to acquire the most recent literature.

EPA will offer state drinking water agencies and the public at large an opportunity to provide information to EPA on any impacts to ground water believed to be associated with hydraulic fracturing by a request for public comment. Submissions will be reviewed by EPA staff for information pertinent to this report. In addition a request to provide information and comments regarding incidents of public and private well impacts that could potentially be associated with hydraulic fracturing will be published in the Federal Register.

Details on specific methods used to collect information for each of the major report chapters will be included in the Study Methodology chapter of the summary report.

2.2 Data Management

Gathered information and data will be managed so that it will be easy to find any one piece of gathered data. To achieve this goal, the following data management procedures will be used:

- All telephone interviews will be recorded in labeled log books;
- All scientific literature, published maps, existing water quality data, conference proceedings, and trade journal articles will be filed by coal basin;
- Material safety data sheets (MSDSs) and product literature will be filed separately;
- Trip folders (to contain notes and photographs) will be generated for each site visit;
- Computer database searches will be filed separately; and
- Internet websites will be referenced in the summary report.

Most data will be stored in hard copy format. Wherever possible, data will also be stored digitally on compact disc (CD).

3.0 Assessment and Oversight

The quality assurance review process will provide a means to examine if the results and conclusions are verifiable. The review process will result in a determination of whether the conclusions are directly supported by the data or evidence gathered and can be independently validated by others. This quality assurance review process will be hierarchical and will include four review levels:

- Weighted emphasis on data based on source;
- Cross referencing of data sources when possible;
- EPA and other federal agencies review; and
- Review by a Peer Review Panel

EPA review will be accomplished by the Work Assignment Manager in conjunction with other EPA headquarter offices and with other EPA UIC regional offices involved with coalbed methane or hydraulic fracturing. Other federal agencies will be asked to review work products produced by this project, including the USGS and the DOE.

EPA assembled a peer review panel consisting of experts in hydraulic fracturing or associated subjects. The panelists provided comments to EPA regarding the sources of data used in the study, the data themselves, and the conclusions drawn from those data.

Comments will be sought to assist the investigators in making the study as sound as possible and to ensure that the study meets EPA standards for objectivity, evidence, and responsiveness to the study charge. Reviewer comments and objections will be preserved and made a part of the record for the study. Issue papers will be written containing detailed explanations of responses to comments and objections. Reasons for proceeding or not proceeding with the study will be clearly explained.

4.0 Data Validation and Usability

This section describes activities that will take place after the initial collection of data. These activities will determine whether or not the gathered data are useful and helpful to the project.

4.1 Data Review, Verification, and Validation

Subsequent to the data logging process, those reports potentially providing useful information will undergo a selection process to evaluate quality of the information and usefulness to the study. Systematic evaluation of the validity of individual studies, data, and information will therefore include assessment of the following:

- Source of the data and information;
- Qualitative review of the literature;
- Qualitative review of data and information collected;
- Scientific strength of the data and information;
- Geographical, geological, geochemical, spatial, and temporal relevance;
- Relevance to determining baseline conditions;
- Validity of extrapolation to the scope of the Study;
- Characteristics of associations, plausibility, alternative explanations;
- Consistency and specificity of the results;
- Scientific uncertainties, limitations, and confounding variables; and
- Other evaluation parameters as appropriate.

A scale or rating of the data and information with respect to a level of proof required to support conclusions is specifically not proposed as part of this quality assurance process. Establishing a specific level of scientific evidence required to justify a subsequent conclusion would generate significant controversy. Instead, expert judgment will be used to evaluate and weigh available data and information.

4.1.1 Data Verification and Validation Methods

A variety of technical methods and tools will be utilized to sort through the pertinent information and decipher the meaning of the data. These data analysis methods may include:

- Quantitative review of selected data and information collected;
- Tabulating valid data and information;
- Constructing geologic cross sections;
- Evaluating current and historical site operations;
- Review of consistencies between studies;
- Review of sources of discrepancies between studies and information; and
- Other methods/tools as appropriate.

All assumptions will be explicitly documented, the basis for the use of any models explained, lack of evidence noted, and scientific uncertainties described as precisely as possible.

4.2 Reconciliation with User Requirements

This sub-section describes how the gathered and validated data and information will be used to meet the requirements of this project and EPA.

4.2.1 Drawing Conclusions

Drawing conclusions from evaluated and analyzed and summarized data and information will involve judgment as to whether observations are consistent with the study hypotheses/objectives, or, whether some alternative is suggested. The expert investigators will draw upon all evaluated and appropriately summarized data and information; however, no checklist or formula will be applied to arrive at conclusions. Instead, critical scientific reasoning and judgment will be used to draw conclusions. The process of scientific reasoning and judgment will be made explicit by describing and documenting how investigators:

- Assessed completeness of data and information;
- Accounted for lack of evidence and limitations, and impacts on the conclusions;
- Assessed and accounted for bias in original data and/or information;
- Used applicable guidelines and rationales;
- Used any ranges of estimates to arrive at conclusions, where appropriate and;
- Incorporated assumptions into assessments and accounted for the implications of those assumptions in their conclusions.

Conclusions will be drawn within the boundaries of the data and the scope of the study. Lack or absence of evidence will be addressed. The relative strength or weakness of available information to support conclusions, limitations on where a conclusion may apply, and alternative interpretations of data, will be recognized. Any qualification on the use of the data and factors that contribute to uncertainty will be conveyed.

Much of the information obtained from public response to the Federal Register Notice or from other sources cannot be confirmed through review of peer-reviewed publications or other data sources. However, the information will be reviewed and contrasted to evaluate the extent of complaints received and any trends in the complaints within and between individual coalbed methane production basins.

4.2.2 Communication of Findings

This Quality Assurance Plan will be reflected in the communication of scientific findings in a clear, accurate, and complete manner to interested parties. Investigators will communicate:

- The body of technical information that was considered;
- The manner for evaluating, and drawing conclusions from, collected data and information; and
- Conclusions that address the hypotheses/objectives, supported by the results of data evaluation and analysis.

The use of presentation tools such as charts, diagrams, and computer-generated displays will be based on sufficient, valid, and defensible data.

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